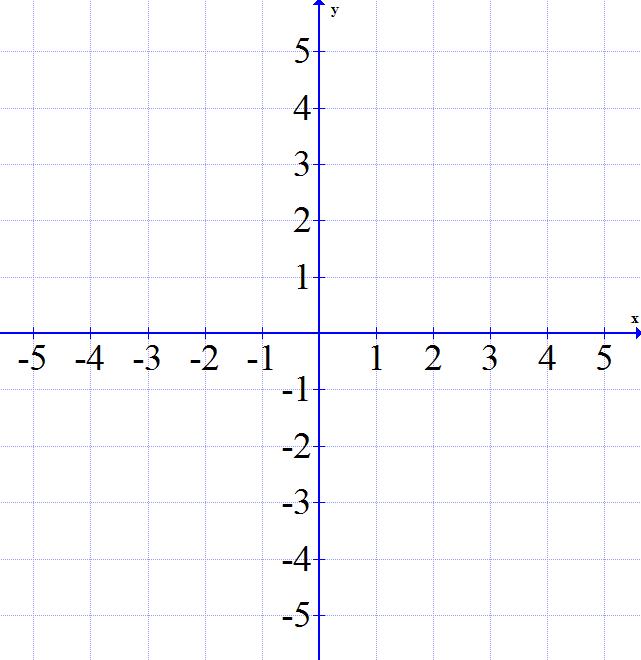
**Trigonometric Ratios for Obtuse Triangles**

53.1°

Q1

Q2

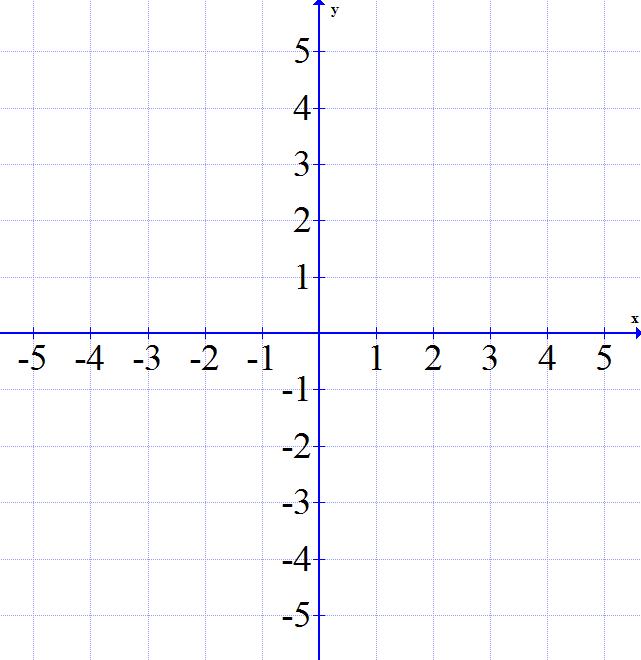
Cartesian coordinate system is divided into **4** **quadrants.**

P

* Label the quadrants on the grid
* Identify the opposite, adjacent and hypotenuse of reference angle 53.1O
* What is the x-coordinate of point P? \_\_\_\_\_  
  What is the y-coordinate of point P? \_\_\_\_\_
* Write the 3 trigonometric ratios using the triangle

Sin 53.1 = Cos 53.1 = Tan 53.1 =

*Notice that the length of the adjacent side is the x-coordinate and the length of the opposite side is the y-coordinate.   
We can use this idea to find the trigonometric ratios of obtuse angles.*

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**α**

126.9°

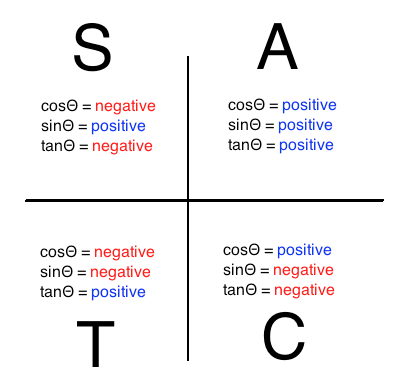
Sin 126.9 = O/H Cos 126.9 = A/H Tan 126.9 = O/A

**5**

**4**

= 4/5

**-3**



Where are sin, cos and tan positive? This is called the CAST rule:

Notice: For an angle between 0° and 180°,

* If cos or tan are positive the angle is in quadrant \_\_\_
* If cos or tan are negative the angle is in quadrant \_\_\_
* If sin is positive the angle could be in either quadrant \_\_\_ or \_\_\_.

There are always two angles that could give us the same sin ratio.

**1) SINE RATIO (if positive one acute one obtuse, if negative one obtuse)**

|  |  |
| --- | --- |
| **Example:** Angle A is between 0ᴼ and 180ᴼ. Determine all measures of angle A in the following case: sin A = 0.2079  **Solution:** According to CAST rule, sin A is positive in two quadrants: 1 and 2. | |
| **ANGLE 1: ACUTE ANGLE in Q1** | **ANGLE 2: OBTUSE ANGLE in Q2** |
| Sin-1 0.2079 = A  12o  A = 12o | Once, we find the acute angle, the obtuse one is rather easy.  12o  168o  180 – 12 = 168  **Check:** sin 168o = \_\_\_\_\_ |

**CONCLUSION:** A is 12 or 168 degrees.

**Your turn:**

|  |  |
| --- | --- |
| a) sin A = 0.4045  *Since sin ratio is +ve in two quadrants. You need to find two angles: acute and obtuse.*  **Acute**: \_\_\_\_\_\_ **Obtuse**: \_\_\_\_\_\_\_\_ | b) sin A = 0.8345 |

**2) COSINE RATIO (if positive only one acute, if negative one obtuse)**

**Example:** Angle A is between 0ᴼ and 180ᴼ. Determine all measures of angle A in the following case: cos A = - 0.8191

Note: We will be dealing with only Q1 and Q2 since angle A is between 0 and 180 degrees.

|  |  |
| --- | --- |
| **STEP 1: FIND REFERENCE ANGLE**  **ACUTE ANGLE in Q1** | **STEP 2: REFLECT THE REFERENCE ANGLE**  **INTO Q2 TO FIND THE OBTUSE ANGLE in Q2** |
| *Disregard the sign because it only tells us where the angle is. Since the given cos ratio is -ve. We will seek the angle in Q2.*  35o  cos-1(0.8191) = A  A = 35 (reference angle)  cos 35 is positive. We are interested in the obtuse angle. | 180 – 35 = 145O  35o  35o |

**CONCLUSION:** The obtuse angle A is 145o

**TRY**

|  |  |
| --- | --- |
| a) cos A = - 0.6345 | b) cos A = - 0.3876 |

**TANGENT RATIO (if positive only one acute, if negative one obtuse)**

**Example:** Angle A is between 0ᴼ and 180ᴼ. Determine all measures of angle A in the following case: tan A = - 2.145

Note: We will be dealing with only Q1 and Q2 since angle A is between 0 and 180 degrees.

|  |  |
| --- | --- |
| **STEP 1: FIND REFERENCE ANGLE**  **ACUTE ANGLE in Q1** | **STEP 2: REFLECT THE REFERENCE ANGLE**  **INTO Q2 TO FIND THE OBTUSE ANGLE in Q2** |
| *Disregard the sign because it only tells us where the angle is. Since the given tan ratio is -ve. We will seek the angle in Q2.*  *.*  tan-1(2.145) = A  65o  A = 65 (reference angle)  tan 65 is positive. We are interested in the obtuse angle. | 180 – 65 = 115O  65o  65o |

**CONCLUSION:** The obtuse angle A is 115o.

**YOUR TURN:** Angle A is between 0ᴼ and 180ᴼ. Determine all measures of angle A in the following cases:

|  |  |
| --- | --- |
| a) tan A = 1.428 | b) tan A = -1.428 |

**PRACTICE**

Angle A is between 0ᴼ and 180ᴼ. Determine all measures of angle A in the following cases:

|  |  |  |
| --- | --- | --- |
| a) sin A = 0.1358  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ | b) cos A = - 0.7856  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ | c) tan A = -2.1945  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ |
| d) sin A = 0.8135  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ | e) cos A = -0.2487  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ | f) tan A = - 5.3854  Angle is in the quadrant(s) \_\_\_\_\_\_\_\_\_ |